

## **CLAIMS**

What is claimed is:

1. In a Mobility Agent supporting Mobile IP, a method of registering a Mobile Node, comprising:

receiving a registration request packet from the Mobile Node indicating that a key to be shared by the Mobile Node and an agent with which the Mobile Node is registering is requested;

obtaining a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

storing the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering; and

sending a registration reply packet to the mobile node including the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.

2. The method as recited in claim 1, wherein the agent with which the Mobile Node is registering is the Mobility Agent, the method further comprising:

creating a registration entry for the Mobile Node in a mobility binding table.

3. The method as recited in claim 1, wherein obtaining a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering comprises:

composing a request packet including authentication information associated with the Mobile Node and a key request indicating that a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering is requested;

sending the request packet to a network device adapted for authenticating the Mobile Node; and

receiving a reply packet from the network device in response to the key request, the reply packet including a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.

4. The method as recited in claim 3, wherein the network device is on a home network associated with the Mobile Node and wherein the Mobility Agent is on a foreign network to which the Mobile Node has roamed.

5. The method as recited in claim 3, wherein the network device is a AAA server, wherein the request packet including the authentication information and the key request is a RADIUS access request packet, the RADIUS access request packet including an authentication attribute having the authentication information and a key request attribute having the key request.

6. The method as recited in claim 3, wherein the network device is an AAA server, wherein the reply packet is a RADIUS access accept packet, the RADIUS access accept packet including the first key and the second key.

7. The method as recited in claim 1, wherein the Mobility Agent is adapted for functioning as a Foreign Agent and a Home Agent, the method further comprising:

sending an agent advertisement indicating that the Mobility Agent is configured for functioning as a Home Agent and a Foreign Agent.

8. The method as recited in claim 7, wherein the agent advertisement further indicates an authentication domain associated with the Mobility Agent.
9. The method as recited in claim 7, wherein the agent advertisement further indicates that the Mobile Node should obtain an IP address from a DHCP server.
10. The method as recited in claim 7, wherein the agent advertisement further indicates that the Mobile Node should obtain an IP address from the agent with which the Mobile Node is registering.
11. The method as recited in claim 7, wherein the agent advertisement further indicates that the Mobile Node should obtain an IP address via the Mobility Agent.
12. The method as recited in claim 1, wherein the registration reply packet indicates that the Mobile node needs to re-register with the agent with the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.
13. The method as recited in claim 3, the reply packet including a first key to be provided to the agent with which the Mobile Node is registering and a second key to be provided to the Mobile Node, wherein the first key and the second key are each the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.
14. The method as recited in claim 13, further comprising:

obtaining the second key to be provided to the Mobile Node from the reply packet; and

composing the registration reply packet, the registration reply packet comprising the second key to be provided to the Mobile Node.

15. The method as recited in claim 14, wherein the registration reply packet further comprises a hash of the registration reply packet using the first key to be provided to the agent, the hash of the registration reply packet being provided in a first extension to the registration reply packet and the second key being provided in a second extension to the registration reply packet.

16. The method as recited in claim 13, wherein the agent is the Mobility Agent, the method further comprising:

decrypting the first key to be provided to the agent.

17. The method as recited in claim 1, wherein the agent with which the Mobile Node is registering is a Home Agent on a network to which the Mobile Node has roamed.

18. The method as recited in claim 1, wherein the agent with which the Mobile Node is registering is a Home Agent to be dynamically assigned to the Mobile Node.

19. The method as recited in claim 1, wherein the registration request packet indicates that the agent with which the Mobile Node is registering is a Home Agent to be dynamically assigned to the Mobile Node and the registration reply packet identifies the agent with which the Mobile Node is registering.

20. The method as recited in claim 19, wherein the registration reply packet further indicates that the agent is to be used by the Mobile Node in subsequent registration requests.

21. The method as recited in claim 19, wherein the registration reply packet indicates that the Mobile Node is to obtain the agent from the registration reply packet.

22. The method as recited in claim 19, wherein the agent is a Home Agent on a network to which the Mobile Node has roamed.

23. The method as recited in claim 19, wherein the registration reply packet indicates that the Mobile Node needs to re-register with the agent with the key.

24. The method as recited in claim 23, further comprising:

receiving a second registration request from the Mobile Node, the second registration request being addressed to the agent with which the Mobile Node is registering;

appending a key reply extension to the second registration request, the key reply extension including the key; and

forwarding the second registration request to the agent with which the Mobile Node is registering.

25. The method as recited in claim 24, further comprising:

receiving a second registration reply from the agent with which the Mobile Node is registering;

removing the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering from storage; and

forwarding the second registration reply to the Mobile Node.

26. In a Mobile Node, a method of registering with an agent supporting Mobile IP, comprising:

composing a registration request having a key request extension requesting a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

sending the registration request to a Mobility Agent supporting Mobile IP;

receiving a registration reply from the Mobility Agent, the registration reply indicating that the Mobile Node needs to re-register with the agent with which the Mobile Node is registering and having a key reply extension including the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

obtaining the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering from the key reply extension of the registration reply; and

storing the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering, thereby enabling the Mobile Node to subsequently register directly with the agent.

27. The method as recited in claim 26, wherein the agent with which the Mobile node is registering is the Mobility Agent.

28. The method as recited in claim 26, further comprising:

receiving an agent advertisement indicating an authentication domain associated with the Mobility Agent; and

determining whether the authentication domain associated with the Mobility Agent is different from that of the Mobile Node;

wherein composing a registration request having a key request extension is performed when it is determined that the authentication domain associated with the Mobility Agent is different from that of the Mobile Node.

29. The method as recited in claim 28, wherein the agent advertisement further indicates that the Mobile Node should obtain an IP address from a DHCP server, the method further comprising:

obtaining an IP address from a DHCP server.

30. The method as recited in claim 28, wherein the agent advertisement further indicates that the Mobile Node should obtain an IP address from the Mobility Agent, the method further comprising:

obtaining an IP address from the Mobility Agent.

31. The method as recited in claim 26, wherein the Mobility Agent is configured for functioning as a Home Agent and a Foreign Agent, the method further comprising:

receiving an agent advertisement from the Mobility Agent indicating that the Mobility Agent is configured for functioning as a Home Agent and a Foreign Agent.

32. The method as recited in claim 26, the method further comprising:

sending a subsequent registration request to the agent including a value associated with the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.

33. The method as recited in claim 32, wherein the subsequent registration request comprises an authentication extension including a hash value of the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.

34. The method as recited in claim 26, the registration reply further comprising an authentication extension, the method further comprising:

authenticating the registration reply using the authentication extension and the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering, thereby verifying that the Mobile Node and the agent with which the Mobile node is registering both share the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.

35. The method as recited in claim 26, wherein the agent with which the Mobile Node is registering is a Home Agent on a network to which the Mobile Node has roamed.

36. The method as recited in claim 26, wherein the agent with which the Mobile Node is registering is a Home Agent to be dynamically assigned to the Mobile Node.

37. In a Mobile Node, a method of registering with an agent supporting Mobile IP, comprising:



composing a first registration request that requests that a Home Agent be dynamically assigned to the Mobile Node;

sending the first registration request to a Mobility Agent supporting Mobile IP;  
and

receiving a registration reply from the Mobility Agent, the registration reply identifying a Home Agent that has been assigned to the Mobile Node.

38. The method as recited in claim 37, further comprising:

sending a second registration request to the Home Agent that has been assigned to the Mobile Node.

39. The method as recited in claim 37, wherein the registration reply further identifies a key to be shared by the Mobile Node and the Home Agent that has been assigned to the Mobile Node, thereby enabling the Mobile Node to subsequently register directly with the Home Agent that has been assigned to the Mobile Node.

40. The method as recited in claim 39, further comprising:

obtaining the key to be shared by the Mobile Node and the Home Agent that has been assigned to the Mobile Node from the registration reply; and

composing a second registration request including the key to be shared by the Mobile Node and the Home Agent that has been assigned to the Mobile node;

sending the second registration request to the Home Agent that has been assigned to the Mobile Node.

41. The method as recited in claim 37, wherein the first registration request further indicates that a key to be shared by the Mobile Node and the Home Agent be generated.

42. In network device adapted for performing authentication of a mobile node, a method of authenticating a registration request associated with a Mobile Node, comprising:

receiving a request packet including authentication information associated with the Mobile Node and indicating that a Home Agent is to be assigned to the Mobile node;

authenticating the Mobile Node using the authentication information;

assigning a Home Agent to the Mobile Node, the Home Agent being located on a foreign network that the Mobile Node is visiting; and

sending a reply packet identifying the Home Agent assigned to the Mobile Node.

43. The method as recited in claim 42, wherein the network device is a AAA server, wherein the request packet is a RADIUS access request packet and wherein the reply packet is a RADIUS access reply packet.

44. In a Mobility Agent supporting Mobile IP, a method of registering a Mobile Node, comprising:

receiving a registration request packet from the Mobile Node indicating that a Home Agent with which the Mobile Node is to register is to be assigned to the Mobile Node;

obtaining a Home Agent assignment, the Home Agent assignment identifying the Home Agent with which the Mobile Node is to register; and

sending a registration reply packet to the Mobile Node identifying the Home Agent with which the Mobile Node is to register.

45. The method as recited in claim 44, wherein the Home Agent with which the Mobile Node is registering is the Mobility Agent, the method further comprising:

creating a registration entry for the Mobile Node in a mobility binding table.

46. The method as recited in claim 44, wherein obtaining a Home Agent assignment comprises:

composing a request packet including authentication information associated with the Mobile Node and indicating that a Home Agent with which the Mobile Node is registering is to be assigned to the Mobile Node

sending the request packet to a network device adapted for authenticating the Mobile Node; and

receiving a reply packet from the network device, the reply packet identifying the Home Agent with which the Mobile Node is registering.

47. The method as recited in claim 46, wherein the network device is a AAA server, wherein the request packet is a RADIUS access request packet, the RADIUS access request packet including an authentication attribute having the authentication information and an attribute indicating that a Home Agent is to be assigned to the Mobile Node.

48. The method as recited in claim 46, wherein the network device is an AAA server, wherein the reply packet is a RADIUS access accept packet, the RADIUS access accept packet identifying the Home Agent.

49. The method as recited in claim 44, wherein the Mobility Agent is adapted for functioning as a Foreign Agent and a Home Agent, the method further comprising:

    sending an agent advertisement indicating that the Mobility Agent is configured for functioning as a Home Agent and a Foreign Agent.

50. The method as recited in claim 49, wherein the agent advertisement further indicates an authentication domain associated with the Mobility Agent.

51. The method as recited in claim 49, wherein the agent advertisement further indicates that the Mobile Node should obtain an IP address via the Mobility Agent.

52. The method as recited in claim 44, wherein the registration reply packet further includes a key to be shared by the Mobile node and the Home Agent with which the Mobile Node is registering.

53. The method as recited in claim 52, wherein the registration reply packet further indicates that the Mobile node needs to re-register with the Home Agent with the key to be shared by the Mobile Node and the Home Agent with which the Mobile Node is registering.

54. The method as recited in claim 52, the reply packet including a first key to be provided to the Home Agent with which the Mobile Node is registering and a second key to be provided to the Mobile Node, wherein the first key and the second key are each the key to be shared by the Mobile Node and the Home Agent with which the Mobile Node is registering.

55. The method as recited in claim 54, further comprising:

obtaining the second key to be provided to the Mobile Node from the reply packet; and

composing the registration reply packet, the registration reply packet comprising the second key to be provided to the Mobile Node.

56. The method as recited in claim 55, wherein the registration reply packet further comprises a hash of the first key to be provided to the agent, the hash of the first key being provided in a first extension to the registration reply packet and the second key being provided in a second extension to the registration reply packet.

57. The method as recited in claim 54, wherein the Home Agent is the Mobility Agent, the method further comprising:

decrypting the first key to be provided to the Home Agent; and

storing the first key.

58. The method as recited in claim 44, wherein the Home Agent with which the Mobile Node is registering is a Home Agent on a network to which the Mobile Node has roamed.

59. The method as recited in claim 44, wherein the registration reply packet further indicates that the Home Agent is to be used by the Mobile Node in subsequent registration requests.

60. The method as recited in claim 44, wherein the registration reply packet indicates that the Mobile Node is to identify the Home Agent from the registration reply packet.

61. The method as recited in claim 52, wherein the registration reply packet indicates that the Mobile Node needs to re-register with the Home Agent with the key.

62. The method as recited in claim 61, further comprising:

receiving a second registration request from the Mobile Node, the second registration request being addressed to the agent with which the Mobile Node is registering;

appending a key reply extension to the second registration request, the key reply extension including the key; and

forwarding the second registration request to the Home Agent with which the Mobile Node is registering.

63. The method as recited in claim 62, further comprising:

receiving a second registration reply from the Home Agent with which the Mobile Node is registering;

removing the key to be shared by the Mobile Node and the Home Agent with which the Mobile Node is registering from storage; and

forwarding the second registration reply to the Mobile Node.

64. In a Mobility Agent that supports Mobile IP, a method of registering a Mobile Node, comprising:

receiving a registration request packet, the registration request packet having an extension including a key to be shared by the Mobility Agent and the Mobile Node, the Mobility Agent being a Home Agent on a foreign network to which the Mobile Node has roamed.;

obtaining the key from the extension of the registration request packet;

storing the key, thereby enabling the Mobile Node to subsequently register directly with the Mobility Agent;

authenticating the registration request packet using the key; and

sending a registration reply packet to the Mobile Node.

65. The method as recited in claim 64, further comprising:

decrypting the key.

66. The method as recited in claim 64, wherein the registration request packet indicates that an IP address is requested, the method further comprising;

assigning an IP address to the Mobile Node;

wherein the registration reply packet includes the assigned IP address.

67. A Mobility Agent supporting Mobile IP, the Mobility Agent being adapted for registering a Mobile Node, comprising:

a processor; and

a memory, at least one of the processor and the memory being adapted for:

receiving a registration request packet from the Mobile Node indicating that a key to be shared by the Mobile Node and an agent with which the Mobile Node is registering is requested;

obtaining a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

storing the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering; and

sending a registration reply packet to the mobile node including the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.

68. A computer-readable medium storing thereon computer readable instructions for registering a Mobile Node in a Mobility Agent supporting Mobile IP, comprising:

instructions for receiving a registration request packet from the Mobile Node indicating that a key to be shared by the Mobile Node and an agent with which the Mobile Node is registering is requested;

instructions for obtaining a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

instructions for storing the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering; and

instructions for sending a registration reply packet to the mobile node including the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.



69. An apparatus adapted for registering a Mobile Node in a Mobility Agent supporting Mobile IP, comprising:

means for receiving a registration request packet from the Mobile Node indicating that a key to be shared by the Mobile Node and an agent with which the Mobile Node is registering is requested;

means for obtaining a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

means for storing the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering; and

means for sending a registration reply packet to the mobile node including the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering.

70. A computer-readable medium storing thereon computer readable instructions for registering a Mobile Node with an agent supporting Mobile IP, comprising:

instructions for composing a registration request having a key request extension requesting a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

instructions for sending the registration request to a Mobility Agent supporting Mobile IP;

instructions for receiving a registration reply from the Mobility Agent, the registration reply indicating that the Mobile Node needs to re-register with the agent with which the Mobile Node is registering and having a key reply extension including the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

instructions for obtaining the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering from the key reply extension of the registration reply; and

instructions for storing the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering, thereby enabling the Mobile Node to subsequently register directly with the agent.

71. A Mobile Node adapted for registering with an agent supporting Mobile IP, comprising:

means for composing a registration request having a key request extension requesting a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

means for sending the registration request to a Mobility Agent supporting Mobile IP;

means for receiving a registration reply from the Mobility Agent, the registration reply indicating that the Mobile Node needs to re-register with the agent with which the Mobile Node is registering and having a key reply extension including the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

means for obtaining the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering from the key reply extension of the registration reply; and

means for storing the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering, thereby enabling the Mobile Node to subsequently register directly with the agent.

72. A Mobile Node adapted for registering with an agent supporting Mobile IP, comprising:

a processor; and

a memory, at least one of the processor and the memory being adapted for:

composing a registration request having a key request extension requesting a key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

sending the registration request to a Mobility Agent supporting Mobile IP;

receiving a registration reply from the Mobility Agent, the registration reply indicating that the Mobile Node needs to re-register with the agent with which the Mobile Node is registering and having a key reply extension including the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering;

obtaining the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering from the key reply extension of the registration reply; and

storing the key to be shared by the Mobile Node and the agent with which the Mobile Node is registering, thereby enabling the Mobile Node to subsequently register directly with the agent.

73. A computer-readable medium storing thereon computer-readable instructions for registering a Mobile Node with an agent supporting Mobile IP, comprising:

instructions for composing a first registration request that requests that a Home Agent be dynamically assigned to the Mobile Node;

instructions for sending the first registration request to a Mobility Agent supporting Mobile IP; and

instructions for receiving a registration reply from the Mobility Agent, the registration reply identifying a Home Agent that has been assigned to the Mobile Node.

74. A Mobile Node adapted for registering with an agent supporting Mobile IP, comprising:

means for composing a first registration request that requests that a Home Agent be dynamically assigned to the Mobile Node;

means for sending the first registration request to a Mobility Agent supporting Mobile IP; and

means for receiving a registration reply from the Mobility Agent, the registration reply identifying a Home Agent that has been assigned to the Mobile Node.

75. A Mobile Node adapted for registering with an agent supporting Mobile IP, comprising:

a processor; and

a memory, at least one of the processor and the memory being adapted for:

composing a first registration request that requests that a Home Agent be dynamically assigned to the Mobile Node;

sending the first registration request to a Mobility Agent supporting Mobile IP; and

receiving a registration reply from the Mobility Agent, the registration reply identifying a Home Agent that has been assigned to the Mobile Node.

76. A network device adapted for authenticating a registration request associated with a Mobile Node, comprising:

a processor; and

a memory, at least one of the processor and the memory being adapted for:

receiving a request packet including authentication information associated with the Mobile Node and indicating that a Home Agent is to be assigned to the Mobile node;

authenticating the Mobile Node using the authentication information;

assigning a Home Agent to the Mobile Node, the Home Agent being located on a foreign network that the Mobile Node is visiting; and

sending a reply packet identifying the Home Agent assigned to the Mobile Node.

77. A computer-readable medium storing thereon instructions for registering a Mobile Node by a Mobility Agent supporting Mobile IP, comprising:

instructions for receiving a registration request packet from the Mobile Node indicating that a Home Agent with which the Mobile Node is to register is to be assigned to the Mobile Node;

instructions for obtaining a Home Agent assignment, the Home Agent assignment identifying the Home Agent with which the Mobile Node is to register; and

instructions for sending a registration reply packet to the Mobile Node identifying the Home Agent with which the Mobile Node is to register.

78. A Mobility Agent supporting Mobile IP and adapted for registering a Mobile Node, comprising:

means for receiving a registration request packet from the Mobile Node indicating that a Home Agent with which the Mobile Node is to register is to be assigned to the Mobile Node;

means for obtaining a Home Agent assignment, the Home Agent assignment identifying the Home Agent with which the Mobile Node is to register; and

means for sending a registration reply packet to the Mobile Node identifying the Home Agent with which the Mobile Node is to register.

79. A Mobility Agent supporting Mobile IP and adapted for registering a Mobile Node, comprising:

a processor; and

a memory, at least one of the processor and the memory being adapted for:

receiving a registration request packet from the Mobile Node indicating that a Home Agent with which the Mobile Node is to register is to be assigned to the Mobile Node;

obtaining a Home Agent assignment, the Home Agent assignment identifying the Home Agent with which the Mobile Node is to register; and

sending a registration reply packet to the Mobile Node identifying the Home Agent with which the Mobile Node is to register.

80. A computer-readable medium storing thereon computer-readable instructions for registering a Mobile Node in a Mobility Agent that supports Mobile IP, comprising:

instructions for receiving a registration request packet, the registration request packet having an extension including a key to be shared by the Mobility Agent and the Mobile Node, the Mobility Agent being a Home Agent on a foreign network to which the Mobile Node has roamed;

instructions for obtaining the key from the extension of the registration request packet;

instructions for storing the key, thereby enabling the Mobile Node to subsequently register directly with the Mobility Agent;

instructions for authenticating the registration request packet using the key;  
and

instructions for sending a registration reply packet to the Mobile Node.

81. A Mobility Agent that supports Mobile IP and adapted for registering a Mobile Node, comprising:

means for receiving a registration request packet, the registration request packet having an extension including a key to be shared by the Mobility Agent and the Mobile Node, the Mobility Agent being a Home Agent on a foreign network to which the Mobile Node has roamed.;

means for obtaining the key from the extension of the registration request packet;

means for storing the key, thereby enabling the Mobile Node to subsequently register directly with the Mobility Agent;

means for authenticating the registration request packet using the key; and

means for sending a registration reply packet to the Mobile Node.

82. A Mobility Agent that supports Mobile IP and adapted for registering a Mobile Node, comprising:

a processor; and

a memory, at least one of the processor and the memory being adapted for:

receiving a registration request packet, the registration request packet having an extension including a key to be shared by the Mobility Agent and the Mobile Node, the Mobility Agent being a Home Agent on a foreign network to which the Mobile Node has roamed.;

obtaining the key from the extension of the registration request packet;

storing the key, thereby enabling the Mobile Node to subsequently register directly with the Mobility Agent;

authenticating the registration request packet using the key; and

sending a registration reply packet to the Mobile Node.